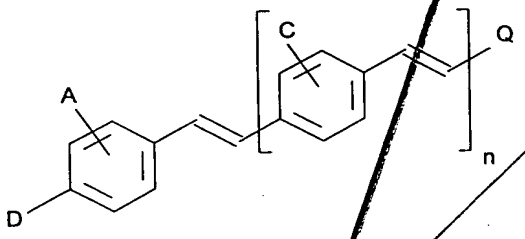
ABSTRACT OF THE DISCLOSURE

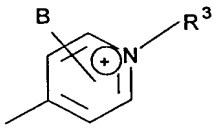
The present invention is directed to styryl dyes having the formula:



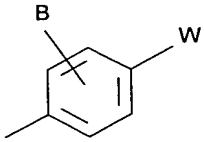
wherein

D is an electron donating group;

Q is an electron acceptor selected from the group consisting of electron acceptors having the formulae:



and



W is an electron accepting group,

R^3 is selected from the group consisting of substituted or unsubstituted alkyl or substituted or unsubstituted aryl moieties,

n is an integer from 0 to 4,

A, B, and C are substituents of their rings and are each independently selected from the group consisting of alkyl, alkoxy, hydroxyalkyl, sulfoalkyl, carboxyalkyl, and hydrogen, and

Y is a counterion

and compositions thereof. The dyes and compositions exhibit superior two-photon absorption cross-sections and are useful in two-photon pumped cavity lasing, two-photon pumped up-conversion lasing, optical power limiting, optical power stabilization, optical signal reshaping, and infrared beam detection and indication. The present invention is also directed to a multiphasic nanostructured composite including a glass having pores, an optically active coating material on the pore surface, such as a sytryl dye of the present invention, and a polymeric material in the pores. Optionally,

the polymeric material can have a second optically active material dispersed therein. These composites are useful in producing multifunctional optical materials, such as broadly tunable lasers. The present invention is also directed to a method for killing cells and viruses. The method includes providing proximate to the cells or viruses a photosensitizer, such as a porphyrin, and a two-photon upconverting dye, such as a styryl dye of the present invention. The dye is then exposed to light in the presence of oxygen under conditions effective to produce a cytotoxic effect on the cells or viruses. These methods are especially useful to kill cells and viruses in biological materials, such as in photodynamic therapy of tumors and cancers or blood purification protocols.

In another aspect, the present invention discloses media and methods for recording data. A three-dimensional matrix including a plurality of dye molecules, such a styryl dye molecule of the present invention, is provided. A first volume element in the matrix is exposed to actinic radiation for a duration and at an intensity effective to alter detectably a fraction between 0.3 and 0.7 of the dye molecules contained therein. The detectably altered dye molecules are substantially uniformly dispersed in the first volume element. The data storage methods and media of the present invention have approximately 10^{12} volume elements per square centimeter, and each of the volume elements can store a single bit, digital information of approximately 8 bits, or analog information. The data storage methods and media of the present invention are particularly useful for storing or archiving a series of two-dimensional black and white or color images, such as frames of a movie. Methods for reading data stored in the data storage media of the present invention using confocal microscopy are also disclosed.